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DIE-BACK OF FORESTS: CONTINUING OBSERVATIONS. MAY AND
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DIE-BACK OF FORESTS - CONTINUING OBSERVATIONS - MAY AND JUNE 1981

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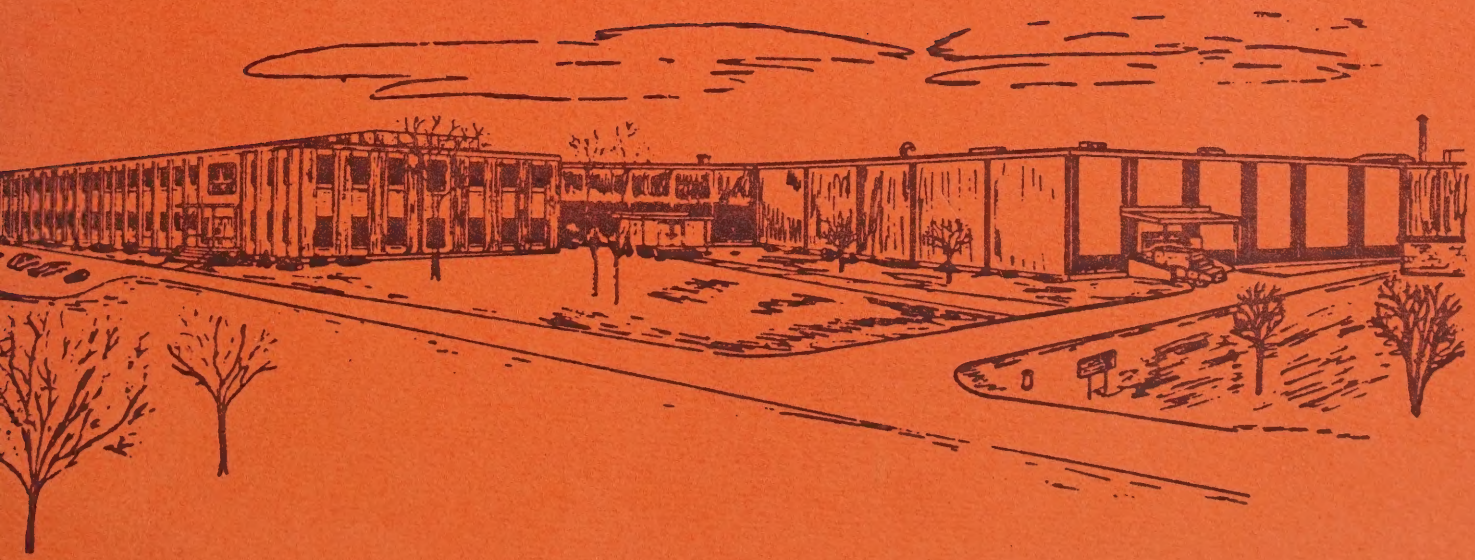
June 1981



DIE-BACK OF FORESTS - CONTINUING OBSERVATIONS - MAY & JUNE 1981 - G.H. Tomlinson

INTRODUCTION

During the course of a visit to Europe in January, 1981, I visited Dr. Ulrich at the University of Göttingen in Germany. During the last fifteen years he has been studying atmospheric acidic deposition, the resulting changes in soil chemistry and the effects observed on forest vegetation. His experimental data have established evidence which links the serious die-back in spruce and beech forests in the poorly buffered soil of the Solling Plateau of Germany with acid deposition.

Following the visit, I issued a Research Memorandum, "Acid Rain and the Forest - The Effect of Aluminum and the German Experience" in February 1981. (1)

During May and June of 1981, I have had an opportunity to visit forested areas of Germany, Sweden, the U.K. and Northern portions of the States of New York, Vermont and New Hampshire. In each of these areas, a similar pattern of die-back is occurring. In discussions with experts who have been concerned with this problem in each of these areas, it is apparent that insect attack and/or other previously identified causes are not involved, and the possibility of a causitive relationship between acid deposition and the deterioration of forest ecosystems should be considered.

Each of these affected areas is characterized by poorly buffered soils in locations receiving relatively heavy acidic deposition. The observed common "syndrome" is a reduction in the rate of growth, an initial drying out and loss of needles or leaves from the top of the trees, this condition moving down the tree until the tree is dead. Final death usually involves a number of years. Dr. Ulrich has found that the loss

of foliage results, in turn, from loss of the fine roots in the mineral soil which are essential for bringing moisture and the required nutrients to the top of the tree. He relates this elimination of the fine roots to the combined effects of soil acidity and the toxic nature of soluble aluminum salts which are mobilized by acid from the aluminum silicate in the clay. In many of the affected areas a lack of reproduction of the same species has occurred.

Other than the causal relationship found by Ulrich in Germany between acid deposition and die-back, the linkage in other areas is circumstantial. However it is circumstantial only because of the limited, but nevertheless valuable, scope of the investigations which have been carried out in these areas to date. It is hoped that these studies can be extended to seek out the underlying mechanisms for this serious loss of forest trees whatever the final reason may be found to be.

In Germany and in the U.K., spruce, fir, Douglas fir and beech are affected. In the north eastern U.S. observations with regard to red spruce and beech indicate that these are the species most affected. Casual observations in certain areas showed a loss of foliage at the top of the trees suggesting that other species such as maple, white birch and hemlock may also be vulnerable. The situation in north eastern Canada will be reviewed in a subsequent memorandum as more information becomes available.

The purpose of this memorandum is, (a) to indicate, in a narrative manner, the areas in which I have observed affected trees, and the points of similarity in the findings. (b) To outline the factors that appear to be leading to tree die-back, and (c) to indicate the need for further research.

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AREAS IN WHICH TREE DIE-BACK HAS BEEN OBSERVED

Germany. I had occasion to return to Sweden in May, and Dr. Peter Rennie, who is in charge of the Canadian Forestry acid rain investigation and Dr. Neal Foster, also involved in these studies, accompanied me to Germany, and later to Sweden. As it happened, Dr. Ulrich had been asked to conduct a three-day field visit for a group of about twenty Swedish foresters and soil chemists, the tour starting at Hamburg and passing through the Syke Forest, the Hartz Mountains, and the Solling Plateau to Göttingen. Unfortunately, because of the timing of my Swedish meetings, I could only spend the first day on this field trip, but it was adequate to give me an appreciation of the problem which has become very serious since 1976, a particularly hot year in Europe. Rennie and Foster completed the trip and spent a few days at Göttingen with Dr. Ulrich and his colleagues at the University. They were favourably impressed by the scientific quality of these on-going studies, and Dr. Rennie is arranging for Dr. Ulrich to visit Canada for special meetings later this year.

During the last few months there have been numerous articles in the German technical and popular press dealing with forest die-back which has occurred at an accelerating rate since 1976, appearing particularly serious this spring. Estimates indicate that as much as 70% of the spruce forests may be affected. The problem in Continental Europe is not confined to Germany and reference has been made to forest die-back in France, Switzerland, Yugoslavia, Czechoslovakia and Poland. (2) (3)

Sweden. Following this, the Canadians rejoined me at Göteborg, in South West Sweden where Dr. Hans Hultberg showed us the area where he has been studying the aluminum and its chemistry in the acidic waters and soils at Lake Gärdsjon and the surrounding area. Aluminum concentration in the streams had been particularly high following the hot year of 1976, and considerable fish mortality resulted (4). At about the same time, Dr. Hultberg, who lives in this forested area, noted the drying out and loss of needles from the spruce, and at the time of our visit the trees looked very similar to those seen in Germany. However, I should point out that no studies have yet been conducted by foresters in this part of Sweden that would establish the linkage

between rain, aluminum and die-back, but it is expected that such an investigation will be carried out. Tree die-back, very obvious in the Göteborg area, even as seen driving from the airport, was not observed by me farther North and West in a bus trip from Stockholm to Falun, about three hours drive, indicating that the problem in Sweden is site-specific.

United Kingdom. My wife and I subsequently visited friends in the "New Forest" area of the U.K., which is just north of the coastal area between Southhampton and Bournemouth. To our surprise we found a similar die-back problem with spruce, fir and beech. The district forest supervisor told us that it had started following 1976, and had been attributed to dryness, and that similar problems had been observed in other areas of England and Scotland, but not in areas with chalk-containing soils, this more fortunate situation having been attributed to a higher soil moisture content. The supervisor had not previously considered an acid-rain linkage. I noted that trees were at various stages of die-back which would suggest that the problem is continuing up to the present. I am hoping to obtain further information through U.K. forestry research channels.

New York State. Dr. Dudley Raynal of the College of Environmental Science and Forestry has carried out a two year study (5) dealing with acid deposition in the forest in the Adirondack area where red spruce die-back is a serious problem. Raynal has also found that there has been a decreasing rate of growth of this species since about 1965. Although medium size roots had penetrated to about 40 cm depth in the mineral soil, the fine roots were found only in the humus layer (16 cm depth). The presence of fine roots in the mineral soil, is important not only for conveying waters but also for moving nutrients up from the mineral soil to counteract the downward loss of nutrient and mineral soil from humus by the leaching action of percolating water. Nitrifying bacteria were found to be absent from the spruce forest soils (humus, pH 3.4; pH 3.5 in upper 15 cm of mineral soil) but were present in soil of pH 6.1 at Natural Bridge where there is an intrusion of marble ($CaCO_3$) into the granite bed-rock. The die-back of spruce in the Adirondacks cannot be related to insect or other recognized cause and there is a circumstantial implication that acid deposition may be involved. Further study is obviously needed.

Unlike red-spruce, the growth rate of white pine has been found by Raynal to be satisfactory and in one site its annual growth rate has actually increased, this possibly resulting from the fertilizing effect of nitrate present in the rain.

In driving and hiking through the Adirondack area, it was noted that in many areas a high percentage of red spruce showed obvious signs of die-back similar to that observed in Europe. Relatively early signs were observed near Adirondack Log, South of Lake Placid, and on the road to Lake Placid Manor at the entrance to the golf course near the Lake. Beech die-back was also observed in this location. Damage to spruce appeared to be greatest in the westerly portion of the forest near Russel (Highway 40) and Degrasse where large areas of dead spruce were observed. At Natural Bridge, where higher pH soils had been previously identified (5) the crowns of spruce appeared satisfactory. (Crowns of red-spruce were also undamaged at the Morgan Arboretum adjacent to the Senneville Lab).

An additional problem was observed with red spruce in the Adirondack region namely that the previous year's needles had turned brown and were dropping off, and in many cases the terminal buds on the branches appeared to be atrophied. This appeared to be separate from and in addition to crown die-back. In many young under-story spruce (about 1 m in height) the needles grown in 1979 and earlier, although green, were very dry and it appeared that the trees would not survive. In a subsequent visit to areas of Vermont and New Hampshire, the brown needles syndrome was noted only in areas where crown damage was also apparent. In areas where little, if any crown damage was seen, most spruce were free of this problem or at most it was apparent on only a few branches. It has been suggested that the brown needles problem is related to the heavy thaw with loss of snow cover in February 1981 followed by cold weather later in the winter. However the fact that it appears to be most noticeable in areas where crown die-back is occurring and is not observed in other areas, apparently subject to the same weather, would suggest that stressed trees are most vulnerable.

Vermont and New Hampshire. Dr. Richard Vogelmann (6) and his associates at the University of Vermont are studying the red-spruce die-back problem on four mountain slopes ranging from Jay Peak near the Quebec border to Camels Hump 70 km south. The principal study deals with Camels Hump, a mountain which has never been harvested, where they had established test areas at several elevations in 1965, and measured the number of stems/ha and the basal area in m^2/ha. Re-examination of these sites on this mountain in 1979 indicated a reduction in the basal area of living red spruce stems during this period ranging from 40% to 84%. In addition to measurements of living trees the basal area of the dead trees was also determined in 1979 with the following results.

	≥10" diameter red spruces basal area, 1979, m^2/ha	
	Living	Dead
Boreal Forest (880 m)	3.51	7.0
Transition Forest (760 - 880 m)	3.42	8.55
Hardwood Forest (550 - 760 m)	0.86	0.56

Growth rate of the trees had declined since 1965. Comparison of annual ring width of trees of the same diameter (26 cm) showed a decrease from 1.33 mm/a in 1964 to 0.63 mm/a in 1979.

Samples of soil taken in 1965 at the various elevations on Camels Hump are available and analysis of these will be compared with those of current samples. This should allow important insights into the nature of changes that have taken place.

Although substantial die-back on the slopes of Jay Peak had been observed by Dr. Vogelmann, only occasional patches of spruce showing crown die-back were seen from the highway between the Jay Peak area and St. Johnsbury, and east to the New Hampshire border at Lancaster. West of St. Johnsbury to Burlington, crown die-back was apparent in most locations where spruce was seen. Between Burlington and the Canadian border (Highway 89) along Lake Champlain there were very few spruce groves, but those that were seen showed serious damage.

In Northern New Hampshire, the frequency of crown die-back as seen from the highway was considerably lower that that observed in New York State and Western Vermont. In many areas it appeared to be absent. However it was noted along #2 Highway on the Western exposure in Randolph in the draw between Mount Adams and Mount Crescent. Areas of considerable damage were also noted on the side of Mount Crescent but not in the thick woods at its base. It was also observed on the West slope of Kates Hill near Berlin, while on the north east slope crown die-back appeared to be just starting. Here again the damage appears to be site specific.

FACTORS WHICH CAN LEAD TO TREE DIE-BACK

A number of the interacting ecological factors which should be considered in relation to the die-back problem are as follows.

1. The large surface areas, presented by forest foliage and bark, capture and oxidize sulfur dioxide present at very low concentration (parts per billion) in the atmosphere. Atmospheric aerosols, which are responsible for haze, contain sulfuric acid and acid sulfates, and these are also deposited on tree foliage. The resultant accumulation on the tree surfaces is subsequently washed to the forest floor by rain. The quantity of acid resulting in this manner from this "dry deposition" can be substantially greater than that present in the "acid rain" and snow, a problem unrecognized by many investigators in the past. However, the quantities of acid and acid sulfate arriving by each of these different routes is highly dependant on wind direction, distance from source, location on exposed hill-sides and ridges, climate and season, amount of rainfall, etc.

2. In soils the cations needed for plant nutrition namely calcium, magnesium and potassium which are released to the soil by decomposition of tree litter and humus are adsorbed by the negatively charged humus and clay. They thus remain "in storage" in the soil and are available for reabsorption by the roots during periods of growth. Hydrogen ion (H^+) entering the soil, is, in turn, adsorbed by the humus and clay displacing Ca^{2+}, Mg^{2+} and K^+ ions. The released

positive ions, together with equivalents of the negative sulfate ion (SO_4^{2-}), which enters the soil with the rain are thus able to leave the rooting zone in seepage water, eventually entering the streams and lakes.

3. The presence of the inorganic nutrients in the soil solution in a zone available to the roots is essential for continued tree growth. Rain and dust normally contain small quantities of these nutrients which can partially replenish loss from the rooting zone. In addition, these nutrients are released from the mineral rocks, pebbles and grains in the soil by the "weathering" action of acids in the soil water. These acidifying agents originate as carbonic acid (H_2CO_3) formed from the carbon dioxide released from the roots, organic acids formed from the humus and, in more recent times, mineral acids carried in the rain. Unless these soluble salts are taken up in a short time by the roots or adsorbed on the clay, they are leached from the soil by the percolating rain water.

4. As the soil becomes increasingly acid the hydrogen ions sorbed on the clay release, from the aluminum silicate in the clay, aluminum ions and silica, this occurring over a relatively long period of time. By this action of acid on the clay, the aluminum, which was initially chemically immobilized as part of the structure of the clay, becomes soluble, with a portion entering the soil water and the other portion being adsorbed as exchangable aluminum ions on remaining particles of clay. Thus as soil becomes more acid the composition of the ions "stored" by adsorption on the clay becomes drastically changed. At a pH of about 6.5, calcium ions represent approximately 50% of the exchangeable ions held by the clay with magnesium and potassium forming a major portion of the balance, this forming an excellent reserve of tree nutrients. However when the soil reaches a pH of about 4.0, calcium ions make up only about 5% of the exchangeable ions held by the clay, with hydrogen and aluminum ions becoming the dominant exchangeable ions present.

5. Aluminum is toxic to the fine roots of a tree and Ulrich has found that as the soil becomes more acid the fine roots in the mineral soil die-back leaving only those present in the humus. The humus holds relatively little moisture during dry periods and the lack of fine roots in the mineral soil results in a drying out and loss of needles or leaves from the top of the tree. This loss of foliage normally starts during the course of a relatively hot dry year. The fine roots may be partially reestablished during a subsequent cool moist year, but growth at the top of the tree is stunted or completely stopped. If the acid-stressed tree survives, the top is dry and brittle, and may break off during relatively light wind storms. German experience indicates that once the tree becomes acid stressed, the tree will eventually die, death moving down the tree from the top. This is the opposite of the traditionally observed natural die-back of close-growing forest spruce where the lower limbs, which receive reduced sun-light,die off first. Acid stressed trees are more vulnerable to insect and fungus attack which may then be involved as secondary factors, speeding the death of the tree.

6. In addition to the effect of atmospheric related acidification, otherwise natural processes can affect the acidity of the soil. For instance, nitrate, which is required by the tree to produce the protein required for DNA used in cell replication, consumes hydrogen ions when it reacts with carbohydrate during assimilation by the tree as indicated by the following reaction,

$$\underset{\text{(carbohydrate)}}{ROH} + NO_3^- + H^+ \longrightarrow \underset{\text{(protein)}}{RNH_2} + 4\,O$$

This consumption of H^+ has the desirable effect of reducing the acidity of the soil. However this is balanced when the protein in the humus breaks down reforming the nitrate and in the reverse reaction, hydrogen ions are produced, thus increasing acidity.

$RNH_2 + 4\,O \rightarrow ROH + NO_3^- + H^+$. It is apparent that if nitrate assimilation by the tree and nitrate formation by break-down of the humus are in reasonable balance there is no net change in acidity. However

the humus break down rate is highly temperature dependant and during a hot year the substantially increased rate of protein decomposition can result in loss of fine roots and in the case of beech in 1976, zero tree growth. Lack of tree growth in any year eliminates the normal utilization of hydrogen ions through assimilation of nitrate by the tree thus further increasing the acidification problem. Major die-back of spruce, fir, Douglas fir and beech has occurred throughout Europe since 1976. Hultberg (4) observed major acidification of groundwater with increasing aluminum content to streams following the hot year of 1976. He attributed this to a lowering of the water-table which allowed entering air to oxidize iron sulfide to sulfate with release of hydrogen ions, the sulfide having been formed over a period of many years from atmospheric sulfur inputs.

7. When a forest is cleared during the normal harvesting operation the soil, receiving direct sun-light, becomes warmer than it was when under the previous forest cover thus accelerating humus break down with a corresponding acid surge in the soil. The absence of trees, which would otherwise re-assimilate the nitrate, exacerbates the problem. Likens and coworkers (7) have observed that, following forest clearing, the acidity of adjacent streams increases, as does the concentration of nutrient cations, together with nitrate, an indication of substantial losses from the soil. A rapid growth of weeds, berry-bushes, etc. following clearing, by assimilating the nitrate, reduces the acidity and nutrient loss. Temporary storage of nutrients in this weed growth is subsequently returned to the soil when weeds die out as the forest regrows and dominates the area. The addition of powdered calcium carbonate on top of the soil at time of harvest should be considered for sensitive soils where regrowth may be unsatisfactory. Ulrich has found that where beech is dying out in Germany, new trees will not re-establish unless the soil is limed. It should be noted that liming of agricultural soils is considered essential for continuing productivity in many areas and that 600,000 tons per annum of powdered limestone are currently used for this purpose in Quebec fields.

8. In addition to the water which drips through the canopy during rain-fall, a portion, referred to as stem-flow, follows down the branches and bole of the tree. Nicholson (8) found that with Scots pine in Scotland, stem-flow had a pH of 3.3, throughfall a pH of 3.7 while that of the rain itself was 4.2. Ulrich has recently observed that the pH values of the soil near the roots of a tree are substantially lower than those measured in soil a short distance away. For instance in a soil containing calcium carbonate pebbles and having a pH of 6.0 he found values as low as 3.6 on some roots and as high as 5.6 on others, indicating that the water would preferentially follow certain roots, and also that major changes in pH can occur over relatively short distances in a soil. Many forest trees in addition to beech, including maple and white birch which, in certain areas, are now showing crown die-back, funnel a substantial amount of rain-fall into stem flow.

9. The absorption of the different ions and their transmission through the fine root walls of a tree is highly specific. Phosphate, nitrate, calcium, magnesium and potassium are preferentially drawn in, whereas toxic ions such as chloride, sodium and aluminum tend to be excluded. However, Ulrich (9) has found that damaged roots can still act as water conductors from soil to crown, but they cannot control the properties of the solution transported through the tree. Thus toxic ions, including heavy metal ions that may be mobilized in the acidic soil, can reach the leaves and also the cambium where cell division occurs in the growing twig, branch and stem.

Ulrich (10) believes that the die-back of fir, which is now very serious in Europe, has resulted from the entry of bacteria to water conduction systems of the tree thus interfering with this conduction. Fortunately, the fir in New York State and Vermont do not appear to be affected in this way.

Toxicants, such as road salt which may be present in localized areas, may enter a damaged root system. Hutchinson (11), at the University of Maine, found that as much as 23% of the cation exchange capacity of the soil

adjacent to a highway that had been heavily salted consisted of sodium. He attributed localized vegetation damage to this effect. This could be particularly serious in areas where the soil is acidic and only small amounts of the desired calcium magnesium and potassium are held by the soil, since these could be partially displaced by sodium. Hutchinson carried out experiments in 1969-1971 in which calcium carbonate or calcium sulfate was added in controlled quantities in test strips along highways in Maine. I am checking to find out what effect may have been obtained.

10. Although only certain species have been identified with die-back, others may be subsequently affected. The vulnerability of the important tree species to acid-induced damage should be established.

THE NEED FOR FURTHER RESEARCH

The problem of acidification of lake and river waters and the resulting ecological effects are now well studied and documented by many investigators, and a general awareness of the problem is shared throughout the scientific community. No similar state of knowledge prevails in relation to the forest.

At least initially, relatively little damage to trees appeared to result from acid rain and, in fact, the fertilizing effect of nitrate in certain cases resulted in increased rates of growth.

Ulrich's studies have indicated that acid deposition can cause irreversible changes in the soil. He predicted that these changes, could, in time, lead to a collapse of the forest ecosystem. There are indications that "the time is now" in many areas of Germany and Europe.

Translations of two non-scientific articles from the current German press, included as an Appendix to this memorandum, indicate the sudden realization of the severity of the problem and the sense of frustration that this has caused.

There are indications that similar conditions are building up in many other areas of the world, including North America. It is vital that, whatever their nature, the underlying causes for this ecological threat, with its esthetic and extremely serious economic implications, be established beyond all question.

It is urgent that the problem be given immediate attention.

/cns
June 1981

BIBLIOGRAPHY

1. Tomlinson, G.H., "Acid Rain and the Forest. The effect of Aluminum and the German Experience". Research Memorandum 74-7124-13 February 1981. (Re-issued April 1981 after certain relatively minor changes suggested by Dr. Ulrich to whom it had been sent for review). This document lists several references which are relevant to the current memorandum.

2. Winer, R., "Kein Rezept gegen das Baumesterben", Suddeutsche-Zeitung, 28/29.3.1981. (Translation attached in appendix to this memorandum).

3. Häberle, E., "1st der Wald Fur Bonn Nicht Mehr Frhaltenswert?" Wochenblatt Fur Landwirtschaft. No. 35 - 30.8.1980 (translation attached).

4. Hultberg, H., and Wenblad, A., "Acid ground water in South West Sweden, pp 220-221 in "Ecological Input of Acid Precipitation", Sandefjord Conference, SNSF Project, Oslo-As, Norway, 1980.

5. Raynal, D., "Effects of Acid Precipitation on a Forest Ecosystem". New York State Energy Research and Development Authority". ERDA 80 - 29 Dec. 1980.

6. Vogelmann, H., "Decline of Red Spruce in the Green Mountains of Vermont". Dept. of Botany, University of Vermont, Burlington, Private Communication.

7. Likens, G.E., Borman, F.H., Pierce, R.S. and Reiners, W.A., "Recovery of a Deforested Ecosystem". Science, Vol. 199, pp 492-496, 1978.

8. Nicholson, I.A., Cape, N., Fowler, D., Kimmand, J.W. and Paterson, I.S., "Effects of Scots Pine Canopy on the Chemical Composition and Deposition Pattern of Prescipitation", pp 148-149 in "Ecological Input of Acid Precipitation". Sandefjord Conference, SNSF Project, Oslo-As, Norway, 1980.

9. Ulrich, B., "Destabilization of Forest Ecosystems by Deposits of Fir Pollutants", Institut fur Bodenkunde und Waldernahrung, Gottingen University, Germany, Private Communication.

10. Ulrich, B., "Eine Okosystems Hypothese Uber Die Ursachen des Tannensterben", Forstwiss, Centrabl, in press 1981.

11. Hutchinson, F.E., "Dispersal of Soil-Bound Sodium from Highway Salts" "Public Works", pp 69-70, 1971.

NO PRESCRIPTION TO HOLD TREE DEATH - A MYSTERIOUS DISEASE HAS HIT THE SPRUCE/ 40% OF THE STAND IS LOST. By Rosemarie Winter. Translated from Suddentsche Zeitung. 28/29 March 1981.

Spruces with yellow instead of green needles, and twigs dropping their needles symbolizes the forest of Munich - a picture of the death of nature which has presented foresters a completely insoluble problem and one that the scientists of to-day do not know how to analyze. The first symptom of sickness in the forest was discovered by the forester of the region during the autumn of the previous year. This rapid deterioration of the health of many spruces 80-120 years old has caused private forest owners and state foresters great concern the last few weeks. Forestry Director Hubert Rössner of the Sauerlach forest office (Munich district) believes that the "beginning of the end" is seen, if his fears come true. Immediately after the discovery of sickness in the 180 sq. kilometer forest overseen by him, which lies between Orton Haar and Grosshelfendorf in the east and Schäftlarn in the west of the Munich district, he sent twigs to the Bavarian Forest Research Institute in Munich for investigation. He has the results already - "large amounts of sulfur in the spruce needles".

This fact allowed the knowledgeable forester to look for the basis for the "death of spruce" in the increasing atmospheric pollution and to disprove the theories postulated by other experts, according to which the sickness of the conifers can be traced back to the weeks-long drought period of 1976. But, not only from the Sauerlach forest officer, a ringing cry of help reached the Institute that each third spruce must be considered sick. Pine shows similar symptoms in the French area; while in the Bavarian forest the fir trees lose their green color and die from presently unknown reasons. The picture of sickness, unknown until now, showed itself even outside the Bavarian boundries throughout west German forests and appeared in Austria and Swiss forests.

A dishearted Forest Director, Hubert Rössner, said it is impossible to visualize a recovery of the forests infected by this epidemic. "A withered tree is likely to fall and healthy trees must be separated from sick trees to avert the inevitable sequence of the dreaded bark beetle infestation." The Forest Director's future prognosis is gloomy. "The spruce leave behind gaps

which the next storm will utilize". Windbreaks will still further decrease the stand. Thus, it falls to the available personnel to move, during this short critical period of time, the sick trees with all dispatch.

Approximately 2000 cu.m of wood in the private forest and 1000 cu.m in the state forest alone were lost through the rapid deterioration in the previous weeks as estimated by Hubert Rössner in his south and east Munich area. From his colleagues in the Mühldorf, Altötting and Starnberg area he had similar dismal information. Using the district police helicopter he flew over his area aided by the guides of the state forest areas and by Professor Schütt of the Botanical Forest Institute of Munich. Above all, it showed that the trees grown in the west boundaries of the forest and many of the higher trees are more susceptible to dying than the spruce in the middle of the forest. From this it was apparent that areas with low level gravel soils and thin humus layers are subject to greatest harm, as for example the areas of Taufkirchen Putzerunn and Höhenbrun.

40% of the spruce forest at this moment suffers acutely from the sickness. Establishing observation areas must serve in measuring the dying spruce remaining so that one can better observe the symptoms of the sickness. Effective counter-measures are initially not possible since one does not know where to start.

IS THE FOREST NO LONGER WORTHWILE FOR BONN? From Wochenblatt fur Landwirtschaft #35, 30.8.1980.

Quietly, almost unnoticed, the most important part of our world, the forest, dies - recovery room for man and beast, air filter, water and raw material storage. Scientists of Munich University give the white fir of the Bavarian area only eight years of future life. Then it will have completely disappeared, like the elms which already have widely disappeared over Europe, destroyed by an aggression fungus. The white fir, a very sturdy tree with a deep tap root comprises 10% of the trees in Baden-Wurtemburg, 40% in several areas of the Black Forest. It was determined through investigation in the Bann forest area, Steinhässle in the Schwabian Murrhardt that in the last 10 years 46% of all white firs have succumbed to the fir death. Since the 1960's, their death was noticed in Bavaria, Baden-Wurtemburg, Czechoslovakia, Switzerland, Yugoslavia, Poland and France. It was initially exclusively older trees that died. Now it is also the young trees which are affected. Without apparent causes, the trees slow down their growth, lose their needles and are thus infested by parasites. Blame can be placed on some bacteria which break down the transport system from the roots to the crown, or maybe also the increased sulfur dioxide content of the air by which the soil becomes over-acidified, and root-toxic light-metal (aluminum) ions are set free. Similar pictures of destruction with other trees, for instance spruce, supports this theory. Thus, in order to be able to determine exactly why they die and institute remedial action, research and money are necessary. Until now this has been set aside by "no", without comment by the Bonn government.

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